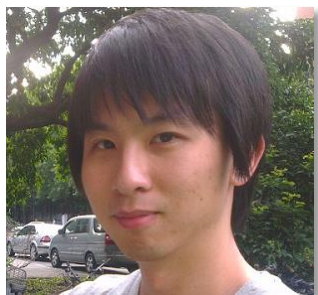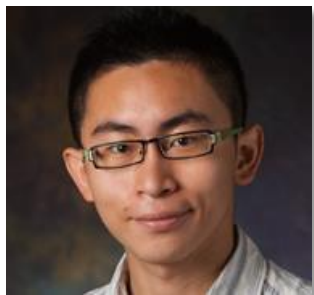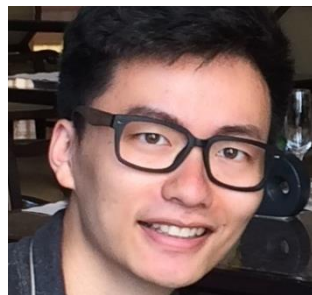# A Comparative Study for Single Image Blind Deblurring

Wei-Sheng Lai
UC Merced

Jia-Bin Huang
UIUC

Zhe Hu
UC Merced

Narendra Ahuja
UIUC

Ming-Hsuan Yang
UC Merced

UNIVERSITY OF CALIFORNIA
UCMERCED

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
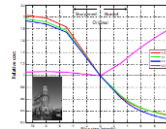
Single Image Blind Deblurring

- ## Algorithms:
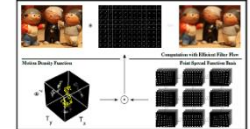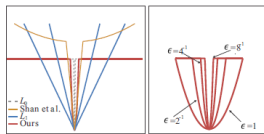

Fergus et al. 2006
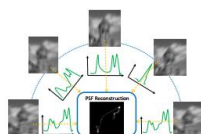

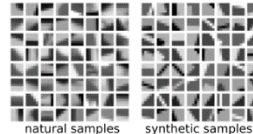Shan et al. 2008

Cho & Lee 2009
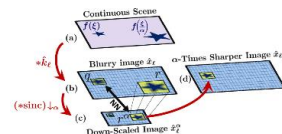

Krishnan et al. 2011

Whyte et al. 2011
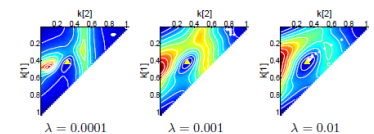

Hirsch et al. 2011

Xu et al. 2013

Zhong et al. 2013

Sun et al. 2013

Michaeli et al. 2014

Pan et al. 2014

Perrone et al. 2014

- ## Datasets:

Levin et al. 2009
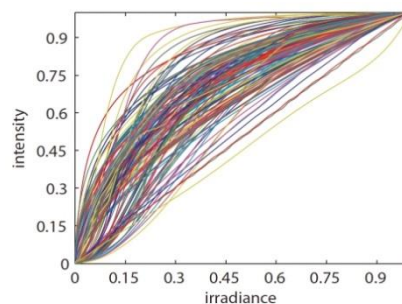

Kohler et al. 2012

Sun et al. 2013

- ## Real images:

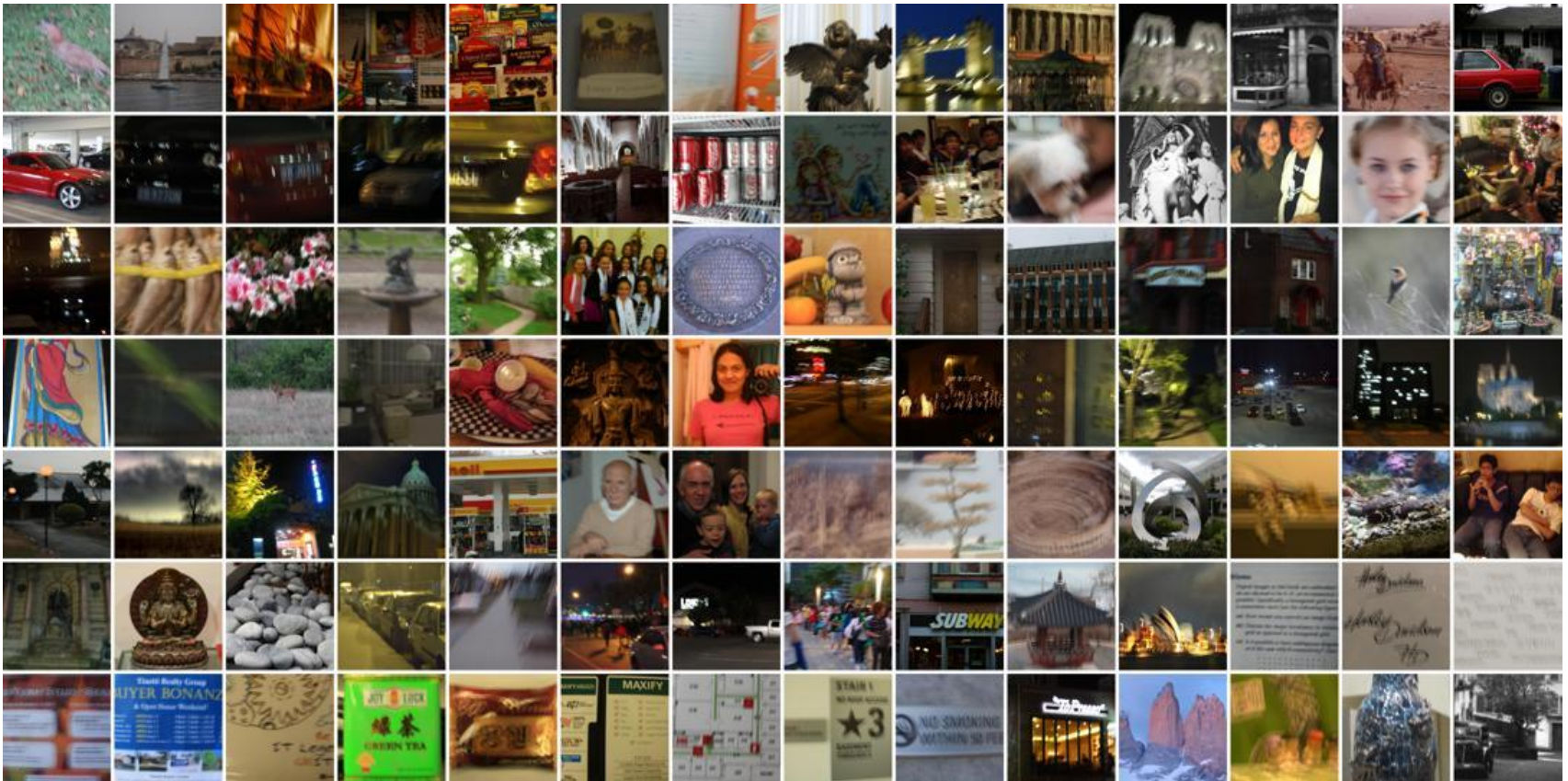
Depth variation

Camera response functions
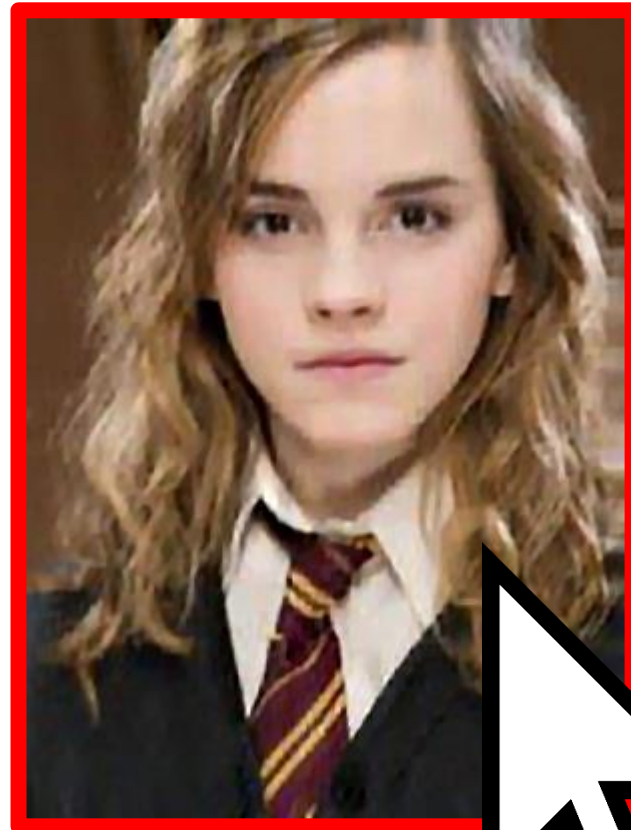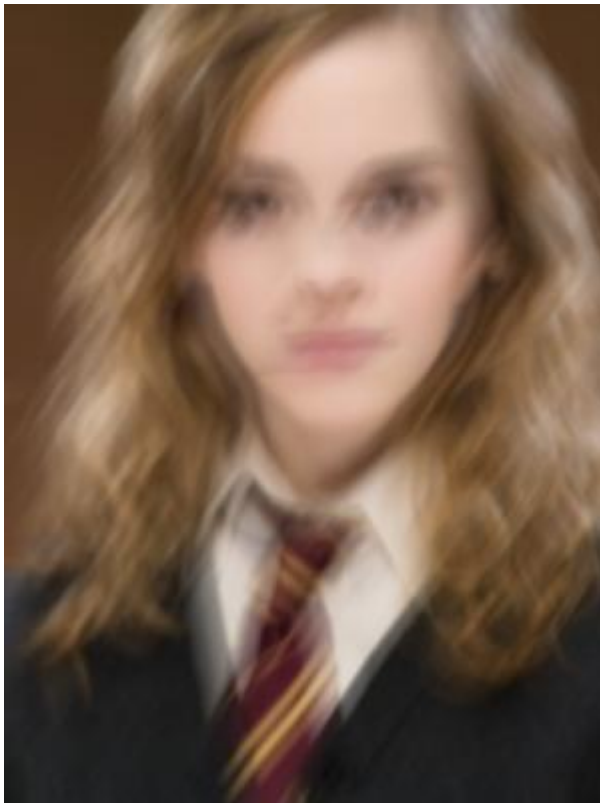

Saturation

Compression artifacts

Our Goal

- Performance evaluation on ***real-world blurred images***
  - a dataset of real images
  - large scale comparative study

User-Study

- Evaluate on 14 methods, 100 images
  - $\binom{14}{2} = 910$ comparisons per image
  - collect about 100k paired comparisons from 2000 subjects

From Paired Comparisons to Full Ranking

- Fit votes to the Bradley-Terry Model (B-T Model)
  - M_{ij} = #times that users choose method i over method j
  - S_i = the B-T score of method i

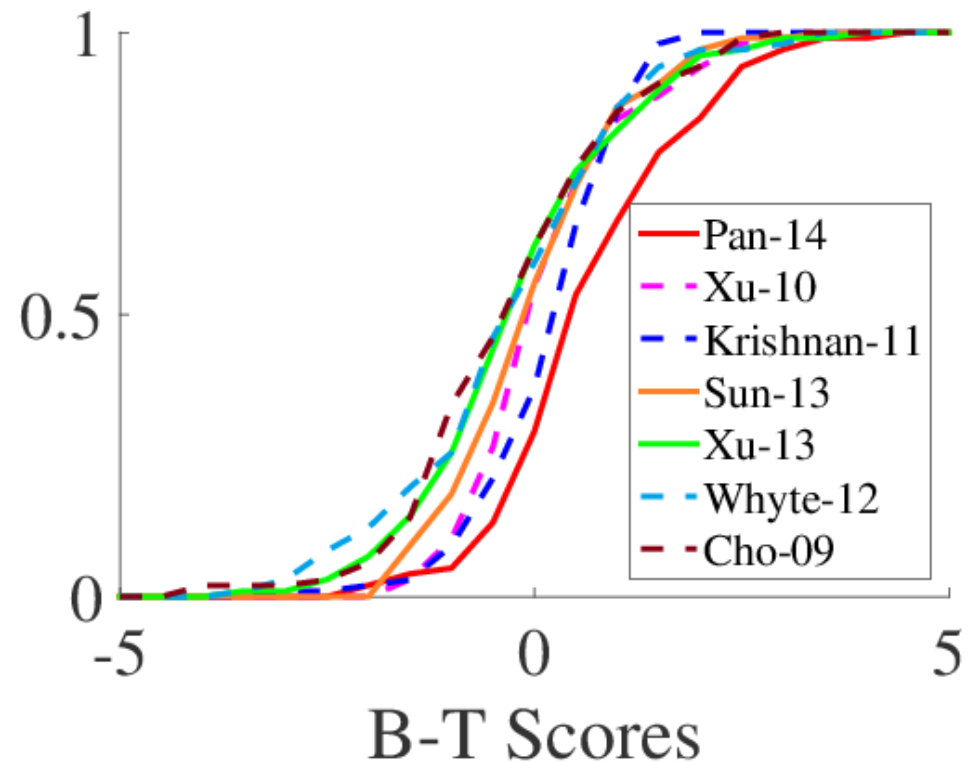$$M_{12} \quad M_{13} \quad \dots \quad M_{45}$$
$$101 \quad \ 80 \qquad \qquad 25$$

B-T Model

$$S_1 \quad \ S_2 \quad \dots \quad S_5$$
$$3.14 \quad 1.59 \qquad \ 2.65$$

Cumulative Frequency

B-T Scores

Legend:
- Pan-14
- Xu-10
- Krishnan-11
- Sun-13
- Xu-13
- Whyte-12
- Cho-09

Comparing Real and Synthetic Datasets
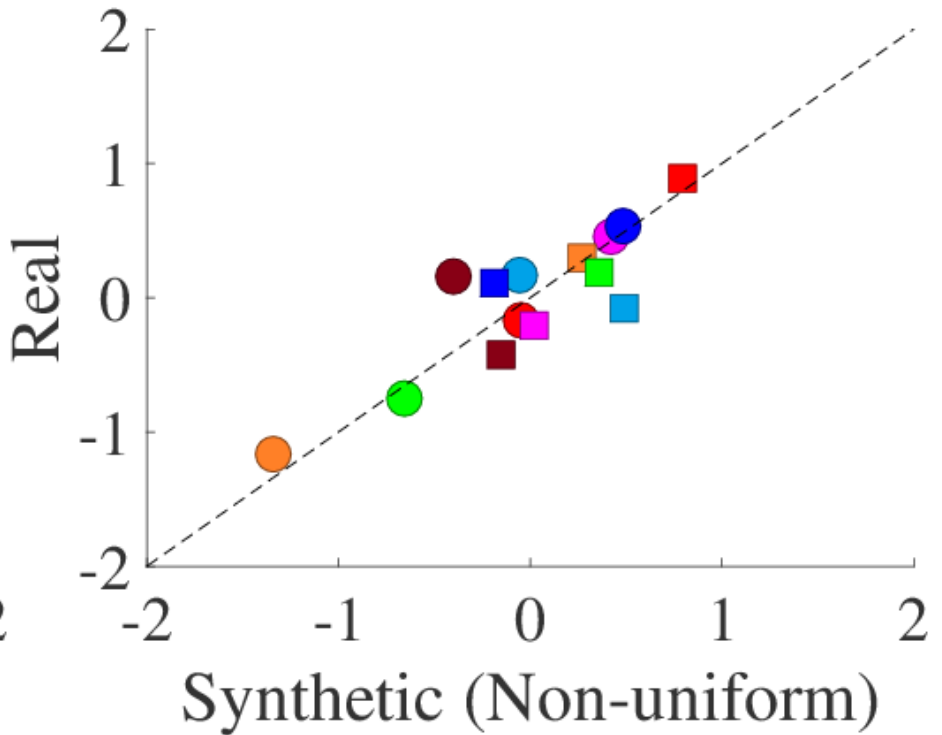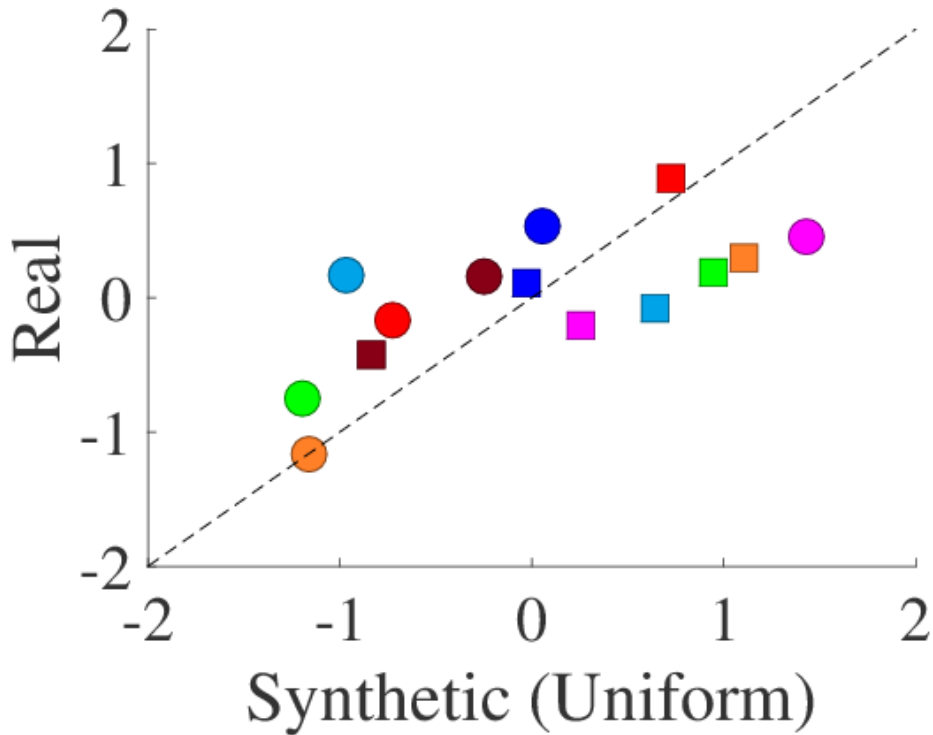
Comparing Image Quality Metrics
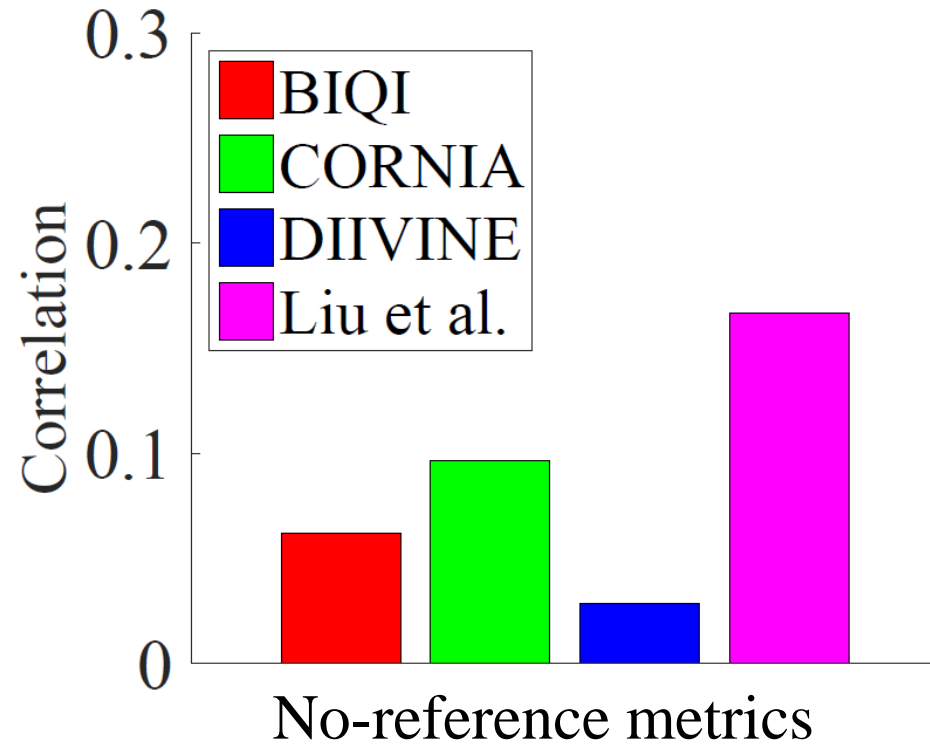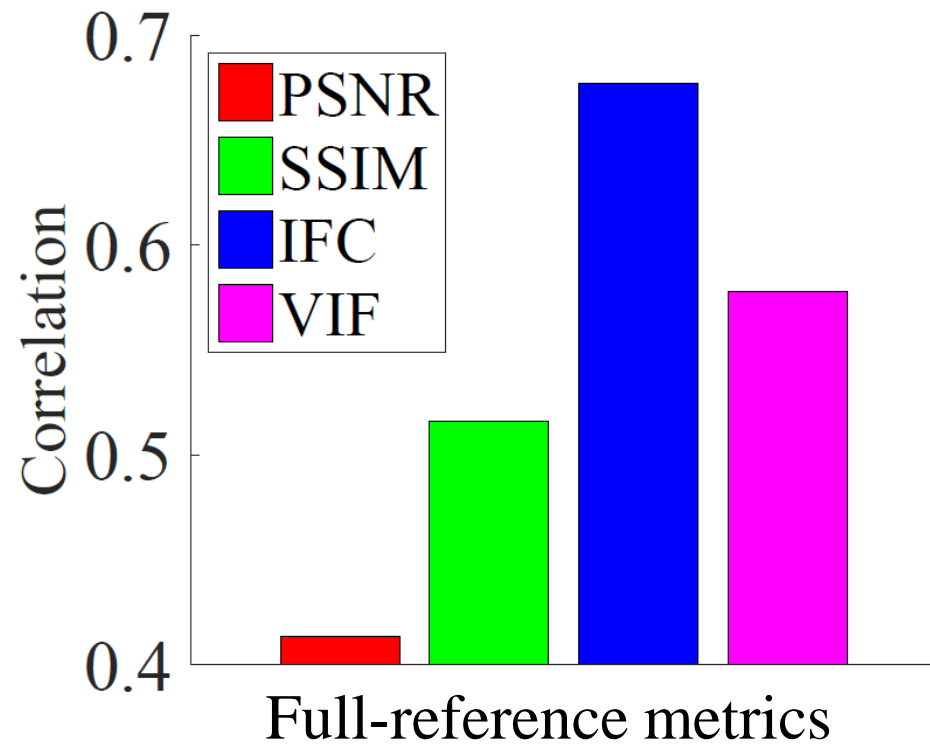
Observations

- **Image priors**: sparse priors are more robust than edge
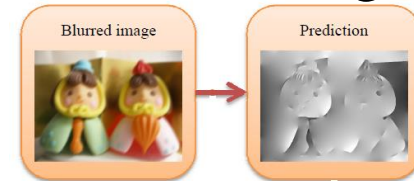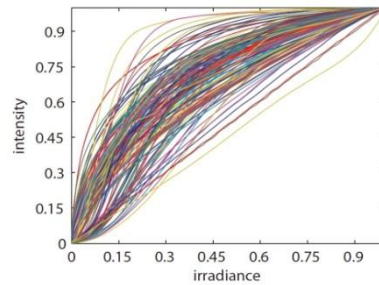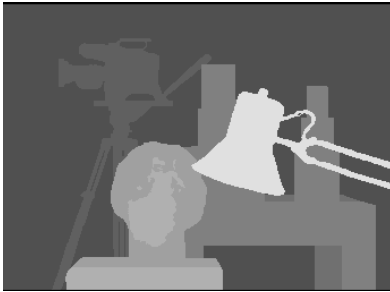
  prediction methods $\dfrac{\|\nabla x\|_1}{\|\nabla x\|_2}, \|x\|_0 \;>$

- **Image formations**:

- **Datasets**: performance on synthetic datasets does not

  reflect the performance on real images

- **Quality metrics**: IFC/VIF > PSNR/SSIM; none of no-

  reference metrics are applicable

Conclusions

- First large scale comparative study on real-world images
  - quantitatively evaluate the progress of the field
  - identify potential research directions

- Code, datasets and results are available: bit.ly/deblur_study

- **Poster #22**